



REPORT ON METAL SHREDDER EMISSIONS TESTING

Temporary Enclosure (TE)

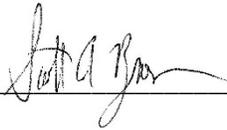
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Revision 4, Final Report
December 4, 2018

COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Submittal:



December 4, 2018

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I hereby certify that the information contained within this report and each appendix section has been reviewed and, to the best of my ability, verified as accurate.

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REPORT REVISION HISTORY

Version	Revision	Date	Pages	Comments
Draft	D0a	10/20/17	All	Draft version of original document.
Final	0	11/06/17	All	Final version of original document.
Final	1	01/17/17	Cover, ii, iii, iv, 5, 6, 7, and 22	Revised hydrocarbon method wording. Corrected Table 2-14.
Final	2	04/26/18	Various	Changes made based on comments by the EPA.
Final	3	10/10/18	Cover, ii, iii, iv, 1, 4, 5, 10 and 11	Clarified tons vs. gross tons, changed TNMHC “as carbon” to “as propane” and minor wording changes.
Final	4	12/04/18	Cover, ii, ii, 1-5, 9 and 11	Minor revisions per EPA’s request

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ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)	ft ² (square feet)	ml (milliliter(s))
acfm (actual cubic feet per minute)	ft ³ (cubic feet)	MMBtu (million British thermal units)
ACI (activated carbon injection)	ft/sec (feet per second)	MW (megawatt(s))
ADL (above detection limit)	FTIR (Fourier Transform Infrared Spectroscopy)	NCASI (National Council for Air and Stream Improvement)
AIIG (ammonia injection grid)	FTRB (field train reagent blank)	ND (non-detect)
APC (air pollution control)	g (gram(s))	NDIR (non-dispersive infrared)
AQCS (air quality control system(s))	GC (gas chromatography)	NDO (natural draft opening)
ASME (American Society of Mechanical Engineers)	GFAAS (graphite furnace atomic absorption spectroscopy)	NESHAP (National Emission Standards for Hazardous Air Pollutants)
ASTM (American Society for Testing and Materials)	GFC (gas filter correlation)	ng (nanogram(s))
BDL (below detection limit)	gr/dscf (grains per dry standard cubic feet)	Nm ³ (Normal cubic meter)
Btu (British thermal units)	> (greater than)/ ≥ (greater than or equal to)	% (percent)
CAM (compliance assurance monitoring)	g/s (grams per second)	PEMS (predictive emissions monitoring systems)
CARB (California Air Resources Board)	H ₂ O (water)	PFGC (pneumatic focusing gas chromatography)
CCM (Controlled Condensation Method)	HAP(s) (hazardous air pollutant(s))	pg (picogram(s))
CE (capture efficiency)	HI (heat input)	PJFF (pulse jet fabric filter)
°C (degrees Celsius)	hr (hour(s))	ppb (parts per billion)
CEMS (continuous emissions monitoring system(s))	HR GC/MS (high-resolution gas chromatography and mass spectrometry)	PPE (personal protective equipment)
CFB (circulating fluidized bed)	HRVOC (highly reactive volatile organic compounds)	ppm (parts per million)
CFR (Code of Federal Regulations)	HSRG(s) (heat recovery steam generator(s))	ppmdv (parts per million, dry volume)
cm (centimeter(s))	HVT (high velocity thermocouple)	ppmwv (parts per million, wet volume)
COMS (continuous opacity monitoring system(s))	IC (ion chromatography)	PSD (particle size distribution)
CT (combustion turbine)	IC/PCR (ion chromatography with post column reactor)	psi (pound(s) per square inch)
CTI (Cooling Technology Institute)	ICP/MS (inductively coupled argon plasma mass spectrometry)	PTE (permanent total enclosure)
CTM (Conditional Test Method)	ID (induced draft)	PTFE (polytetrafluoroethylene)
CVAAS (cold vapor atomic absorption spectroscopy)	in. (inch(es))	QA/QC (quality assurance/quality control)
CVAFS (cold vapor atomic fluorescence spectrometry)	in. H ₂ O (inches water)	QI (qualified individual)
DI H ₂ O (de-ionized water)	in. Hg (inches mercury)	QSTI (qualified source testing individual)
%dv (percent, dry volume)	IPA (isopropyl alcohol)	QSTO (qualified source testing observer)
DLL (detection level limited)	ISE (ion-specific electrode)	RA (relative accuracy)
DE (destruction efficiency)	kg (kilogram(s))	RATA (relative accuracy test audit)
DCI (dry carbon injection)	kg/hr (kilogram(s) per hour)	RB (reagent blank)
DGM (dry gas meter)	< (less than)/ ≤ (less than or equal to)	RE (removal or reduction efficiency)
dscf (dry standard cubic feet)	L (liter(s))	RM (reference method)
dscfm (dry standard cubic feet per minute)	lb (pound(s))	scf (standard cubic feet)
dscm (dry standard cubic meter)	lb/hr (pound per hour)	scfm (standard cubic feet per minute)
ESP (electrostatic precipitator)	lb/MMBtu (pound per million British thermal units)	SCR (selective catalytic reduction)
FAMS (flue gas adsorbent mercury speciation)	lb/TBtu (pound per trillion British thermal units)	SDA (spray dryer absorber)
°F (degrees Fahrenheit)	lb/lb-mole (pound per pound mole)	SNCR (selective non-catalytic reduction)
FB (field blank)	LR GC/MS (low-resolution gas chromatography and mass spectrometry)	STD (standard)
FCC (fluidized catalytic cracking)	m (meter)	STMS (sorbent trap monitoring system)
FCCU (fluidized catalytic cracking unit)	m ³ (cubic meter)	TBtu (trillion British thermal units)
FEGT (furnace exit gas temperatures)	MACT (maximum achievable control technology)	TEOM (Tapered Element Oscillating Microbalance)
FF (fabric filter)	MASS [®] (Multi-Point Automated Sampling System)	TEQ (toxic equivalency quotient)
FGD (flue gas desulfurization)	MATS (Mercury and Air Toxics Standards)	ton/hr (ton per hour)
FIA (flame ionization analyzer)	MDL (method detection limit)	ton/yr (ton per year)
FID (flame ionization detector)	μg (microgram(s))	TSS (third stage separator)
FPD (flame photometric detection)	min. (minute(s))	USEPA or EPA (United States Environmental Protection Agency)
FRB (field reagent blank)	mg (milligram(s))	UVA (ultraviolet absorption)
FSTM (flue gas sorbent total mercury)		WFGD (wet flue gas desulfurization)
ft (feet or foot)		%wv (percent, wet volume)

1. PROJECT OVERVIEW

Test Program Summary

SMM New England Corporation (SMMNEC) contracted CleanAir Engineering (CleanAir), under the direction of Trinity Consultants, to perform a test program on the Temporary Enclosure (TE) Outlet at the metal shredding facility (hereinafter Facility), located in Johnston, Rhode Island. The test program included the following objectives:

- Perform testing to comply with the United States Environmental Protection Agency (USEPA) Clean Air Act (CAA) Testing Order, dated October 11, 2016, in accordance with the Shredder Emissions Testing Protocol, dated January 3, 2017, and subsequently revised, prepared by Trinity Consultants and approved by the USEPA (hereinafter Testing Protocol). The Testing Protocol and design was as reviewed and approved by the USEPA for establishing an emission factor for constituents that may be detected in air emissions from specified sources, including volatile organic compounds (VOCs), particulate matter (PM), and hazardous air pollutants (HAPs). Testing was both designed and performed to evaluate emissions of VOCs, PM, and HAPs from metal shredding and separation activity at the Facility;
- Conducting testing under conditions above and beyond what would occur during the Facility’s normal operating conditions, primarily for the purposes of establishing the Facility’s potential to emit air pollutants.

A summary of the test program results is presented in Tables 1-1 through 1-3. Section 2 Results provides a more detailed account of the test conditions and data analysis. Test program information, including the test parameters, on-site schedule and a project discussion, begins on page 3.

**Table 1-1:
 Summary of Results – Particulate, TNMHC, and TE Pressure Drop**

<u>Source</u> Constituent	<u>Sampling</u> Method	<u>50/50 Mix</u> Average (Emission)	<u>25/75 Mix</u> Average (Emission)
<u>TE Stack</u>			
Actual mix (light iron/automobiles)	Gravimetric	46/54	23/77
PM (lb/ton of feed)	EPA M5	0.0032	0.0029
TNMHC (lb/ton of feed)	EPA M25A, 18	0.13	0.10
TE Pressure Drop ("H ₂ O)	EPA M204	-0.051	-0.064

**Table 1-2:
 Summary of Results – TO-15 and Tentatively Identified Compound (TIC) VOCs**

<u>Source</u> Constituent	50/50 Mix Average Emission	25/75 Mix Average Emission
TO-15 Results (lb/ton of feed)		
<u>TE Outlet</u>		
Chlorodifluoromethane*	2.81E-03	9.24E-04
Propene	4.39E-04	7.86E-05
Dichlorodifluoromethane*	2.85E-03	8.27E-04
Dichlorotetrafluoroethane*	4.55E-03	ND
Trichlorofluoromethane*	<4.76E-05	5.00E-04
TO-15 TIC Results (lb/ton of feed)		
<u>TE Outlet</u>		
Norflurane*	4.58E-03	1.16E-03
1-Chloro-1-fluoroethene	3.89E-05	1.55E-05
Isobutane	<1.57E-04	1.06E-04
Butane	2.70E-04	1.95E-04
2-Methylbutane	2.91E-04	<1.43E-04
Pentane	<8.96E-05	<5.51E-05
Cyclopentane	5.75E-04	<1.44E-04
1,2-Propadiene	<3.47E-05	<6.32E-06
1,1-Difluoroethane	ND	<7.20E-06
2-Methyl-1-propene	ND	<9.25E-05
Total TO-15 VOC	<0.0013	<0.0021
Total Exempt TO-15 VOC	0.015	0.0034

* Exempt VOCs. But potentially regulated as ozone depleting substances.

**Table 1-3:
 Summary of Results – Metals**

<u>Source</u> Constituent	50/50 Mix Average Emission	25/75 Mix Average Emission
<u>TE Outlet</u>		
Mercury (lb/ton of feed)	8.37E-06	5.99E-06
Beryllium (lb/ton of feed)	<6.02E-09	<6.59E-09
Phosphorus (lb/ton of feed)	5.61E-06	5.97E-06
Chromium (lb/ton of feed)	1.06E-06	9.67E-07
Cobalt (lb/ton of feed)	1.09E-07	1.34E-07
Nickel (lb/ton of feed)	7.12E-07	6.33E-07
Copper (lb/ton of feed)	1.72E-06	1.72E-06
Zinc (lb/ton of feed)	1.18E-04	1.16E-04
Arsenic (lb/ton of feed)	<1.20E-07	<1.32E-07
Selenium (lb/ton of feed)	<4.29E-08	<2.99E-08
Silver (lb/ton of feed)	3.89E-07	2.55E-07
Cadmium (lb/ton of feed)	3.89E-07	2.55E-07
Antimony (lb/ton of feed)	2.31E-07	2.23E-07
Barium (lb/ton of feed)	1.61E-06	1.49E-06
Thallium (lb/ton of feed)	<1.94E-08	<2.64E-08
Lead (lb/ton of feed)	4.40E-06	4.33E-06

Test Program Details

Parameters

The test program included the following measurements:

- filterable particulate matter (FPM)
- metals *
- carbon dioxide (CO₂)
- oxygen (O₂)
- volatile organic compounds (VOCs)
- total hydrocarbons (THCs)
- methane (CH₄) and ethane (C₂H₆)
- flue gas composition (e.g., O₂, CO₂, H₂O)
- flue gas temperature
- flue gas flow rate

* Metals included antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, phosphorus, selenium, silver, thallium, and zinc.

Schedule

Testing was performed on September 15, 18 and 20, 2017. The on-site schedule followed during the test program is outlined in Table 1-4.

**Table 1-4:
Test Schedule**

Run Number	Location	Method	Analyte	Date	Start Time	End Time
1	TE Outlet	USEPA Method 5/29	FPM/Metals	09/15/17	09:14	10:33
1	TE Outlet	USEPA Methods 3A/18/25A	O ₂ /CO ₂ /TNMHC	09/15/17	09:14	10:33
1	TE Outlet	USEPA Method TO-15	Speciated VOCs	09/15/17	09:14	10:33
2	TE Outlet	USEPA Method 5/29	FPM/Metals	09/15/17	12:21	13:36
2	TE Outlet	USEPA Methods 3A/18/25A	O ₂ /CO ₂ /TNMHC	09/15/17	12:21	13:36
2	TE Outlet	USEPA Method TO-15	Speciated VOCs	09/15/17	12:21	13:36
3	TE Outlet	USEPA Method 5/29	FPM/Metals	09/18/17	08:38	09:53
3	TE Outlet	USEPA Methods 3A/18/25A	O ₂ /CO ₂ /TNMHC	09/18/17	08:38	09:53
3	TE Outlet	USEPA Method TO-15	Speciated VOCs	09/18/17	08:38	09:53
4	TE Outlet	USEPA Method 5/29	FPM/Metals	09/18/17	11:14	12:33
4	TE Outlet	USEPA Methods 3A/18/25A	O ₂ /CO ₂ /TNMHC	09/18/17	11:14	12:33
4	TE Outlet	USEPA Method TO-15	Speciated VOCs	09/18/17	11:14	12:33
5	TE Outlet	USEPA Method 5/29	FPM/Metals	09/20/17	08:58	12:20
5	TE Outlet	USEPA Methods 3A/18/25A	O ₂ /CO ₂ /TNMHC	09/20/17	08:58	12:20
5	TE Outlet	USEPA Method TO-15	Speciated VOCs	09/20/17	08:58	12:20
6	TE Outlet	USEPA Methods 3A/18/25A	O ₂ /CO ₂ /TNMHC	09/20/17	13:44	15:33
6	TE Outlet	USEPA Method TO-15	Speciated VOCs	09/20/17	13:44	15:33

Discussion

The test program was conducted with the shredder processing two different proportions of two different categories of recyclable materials. Runs 1, 3, and 5 were performed while shredding approximately 50% "light iron" (e.g., appliances and other recyclable material) and 50% recyclable automobiles. Runs 2, 4, and 6 were performed while shredding approximately 25% light iron and 75% automobiles. Process data, including gross tons of metal processed and fan amperage readings collected during each run, are presented in Appendix I of this report. Note all parameters labelled as tons of feed in this document are gross tons of feed.

The TE was used as a means of quantifying emissions from the shredder system. Rigid walls could not be used because the structure had to allow for a possible energy release. The TE was constructed consistent with the Test Protocol. Consistent with the Test Protocol and Equation 204-3 from USEPA Method 204, CleanAir estimated the facial velocity of the TE prior to testing by measuring gaps between the rubber sheets on the north, west, and south sides of the TE. CleanAir also measured gaps between the TE and the UMO on the north, east, and south sides, as well as between the TE and the outfeed conveyor on the west side of the TE. CleanAir's diagrams are available in Appendix J. CleanAir then divided the maximum blower rater of 15,000 scfm by the total natural draft openings (NDOs). This resulted in a calculated facial velocity greater than 200 fpm. Prior to beginning the tests, CleanAir used a Shortridge analyzer and hand-held smoke generator to measure flow rates and direction of flow at accessible locations.

The pressure drop across the TE was monitored and recorded on the TO-15 data sheets during each test run. The sample line used for the pressure drop measurements became clogged during Run 3. This was not discovered until the start of Run 5; therefore, the pressure drops recorded during Runs 3 and 4 yielded non representative and low biased readings. There was an extended delay during Run 5 while the pressure drop sample line was cleared. The average pressure drop reading presented in Table 1-1 only includes Runs 1, 2, 5, and 6. The pressure drop across the TE was found to be $>0.007''$ H₂O, the minimum required to meet EPA Method 204 criteria.

Gas conditions and volumetric flow rate parameters for the TO-15 and total non-methane hydrocarbons (TNMHC) results were obtained from the concurrent Method 5/29 sampling.

A cyclonic flow check on the outlet duct was performed on September 14. The sampling location met the Method 1, Section 11.4 requirements. The data sheet from the cyclonic flow check is presented in Appendix E of this report.

Project Synopsis

Average Gas Molecular Weight, Moisture and Flow Rate

EPA Methods 1, 2, 3, and 4 of 40 CFR 60, Appendix A, in conjuncture with EPA Method 5/29, were used to measure the average flue gas composition and volumetric flow rate. These methods determine several characteristics of the flue gas stream: velocity, moisture, flow rate, and the concentrations of O₂ and CO₂.

Particulate and Metals

As approved by the USEPA, EPA Method 29, "Determination of Metals Emissions from Stationary Sources," in conjunction with EPA Method 5, was used to determine particulate and metals emissions from the outlet exhaust. These methods involve isokinetic sampling of the flue gas and subsequent collection of particulate matter onto a quartz fiber filter and absorption of gaseous metals into an acidic hydrogen peroxide solution. In addition, mercury concentrations were also determined by including acidified potassium permanganate impingers after the peroxide impingers. The front- and back-half sample fractions were combined for analysis by the laboratory Element One, Inc. in Wilmington, North Carolina. Element One also supplied the tared filter media and analysis for the particulate determination as well.

The samples recovered from the probe (acetone rinse and 0.1N HNO₃ rinse) and quartz filter were analyzed gravimetrically for particulate using EPA Method 5 procedures. The particulate samples were then reconstituted with nitric acid. The reconstituted samples and the absorbing solution were digested and analyzed for metals. Inductively coupled plasma-mass spectroscopy (ICP-MS) was used to analyze the samples for each of the target metals except mercury (Hg), which was analyzed using cold vapor atomic absorption spectroscopy (CVAAS).

Hydrocarbons, Total Hydrocarbons and Methane/Ethane

As approved by the USEPA, evaluation of hydrocarbon emissions was performed at the test location using EPA Method 25A. In addition, O₂ and CO₂ concentrations were also monitored using EPA Method 3A.

Using EPA Method 25A, THC's were monitored with analyzers on two scales, 0-100 and 0-1000 as propane; however, concentrations were greater than 100 ppm for the vast majority of each test run. Therefore, the results from the analyzer calibrated on the 0-1000 scale are presented in this report.

The gas sample was continuously extracted from the source and delivered to a series of gas analyzers, which measure the pollutant or diluent concentrations in the gas. The analyzers were calibrated on-site using certified mixtures of calibration gases.

The system utilized a heated stainless steel probe for gas withdrawal. No frit was used due to a saturated gas stream. The end of the probe was connected to a heated filter and a heated Teflon sample line that delivered the sample gases from the TR outlet to the CEM system. The heated sample line was maintained around 250°F in order to prevent condensation of flue gas moisture within the line.

A slipstream from the THC analyzer was directed into a Flexifoil® bag during each run. The bags were analyzed per EPA Method 18 procedures for methane and ethane content by CleanAir's Laboratory in Palatine, Illinois. The methane and ethane concentrations were subtracted from the THC's results to yield TNMHC.

Table 1-5 below lists the analyzers that were used to perform the continuous emissions monitoring:

**Table 1-5:
 Gas Analyzers**

Gas	Reference Method	Analyzer Manufacturer	Principle of Operation
O ₂	EPA 3A	Servomex 1420C	Paramagnetic
CO ₂	EPA 3A	Servomex 1415C	Infrared
THCs	EPA 25A	VIG 20/2 Dual FID	Flame Ionization Detection (FID)

Volatile Organic Compounds and Tentatively Identified Compounds – EPA Method TO-15

This methodology for evaluating volatile organic compounds (VOCs) and tentatively identified compounds (TICs) was performed by collecting integrated samples, utilizing an orifice-based flow controller, into passivated Summa canisters over each of six (6) test runs.

Atmospheric Analysis and Consulting, Inc. (AAC) of Ventura, California, quantified the total mass of all compounds in the Summa Canisters using a GC/MS analyzer. The results included compounds found on the TO-15 compound list, as well as TICs. Those results are presented in Appendix H of this report.

In addition to the Summa canister, the TO-15 sample trains also utilized a condensate knockout and silica gel sorbent tube upstream of the canisters. The knockout impingers were all maintained in an ice bath and the temperature of the gas exiting the final impinger was monitored during each test run. The first two impingers were charged with approximately 20 milliliters of distilled/deionized water, and the third impinger was empty. After the third impinge, a 520/260 mg silica gel tube was placed in series before the gaseous sample reached the Summa.

The contents of the first impinger were recovered separately from the contents of the combined second and third impingers. The samples were shipped on ice to AAC and extracted within the required timeframe. Although instructed to analyze each of these fractions separately, the lab combined the impinger and silica gel fractions into one sample for each test run. After a methylene chloride extraction, the samples were analyzed following EPA Method 8270C using GC/MS. The water/silica gel samples from all sampling runs yielded non-detects for all 8270C compounds. Those results are also presented in Appendix H of this report.

Invalidated Test Runs

During the Run 6 port change it was observed that the Method 5/29 nozzle had unseated itself from the probe liner. The USEPA determined that this Method 5/29 test run would be invalidated and that the remainder of the Run 6 tests could be completed and included in this report. Subsequently, at the request of Trinity Consultants, the Run 6 Method 5/29 test was completed but those results have not been included in this report.

The Run 2 Method 18 methane/ethane sample appeared to have a hole in the Flexifoil bag when it arrived at the laboratory. Therefore, the results of that bag were not subtracted from the THCs result due to the spike recovery coming out low.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices, specifically Appendix C Parameters.

**Table 2-1:
TE Outlet – Particulate – 50/50**

Run No.		1	3	5	Average
Date (2017)		Sep 15	Sep 18	Sep 20	
Start Time (approx.)		09:14	08:38	08:58	
Stop Time (approx.)		10:33	09:53	12:20	
Process Conditions					
R _P	Production rate (tons of feed/hr)	323	310	319	317
P ₁	Process data (light iron/automobiles)	44.28/55.72	48.35/51.65	45.47/54.53	46/54
Gas Conditions					
O ₂	Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂	Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s	Sample temperature (°F)	104	108	111	108
B _w	Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate					
Q _a	Volumetric flow rate, actual (acfm)	13,300	14,100	14,800	14,100
Q _s	Volumetric flow rate, standard (scfm)	12,300	13,000	13,500	12,900
Q _{std}	Volumetric flow rate, dry standard (dscfm)	11,400	11,900	12,500	11,900
Sampling Data					
V _{mstd}	Volume metered, standard (dscf)	33.30	42.51	50.72	42.18
%I	Isokinetic sampling (%)	102.6	103.5	103.4	103.2
Laboratory Data					
m _{filter}	Matter collected on filter(s) (g)	0.01240	0.01900	0.00940	
m _s	Matter collected in solvent rinse(s) (g)	0.00743	0.01804	0.01289	
m _n	Total FPM (g)	0.01983	0.03704	0.02229	
n _{MDL}	Number of non-detectable fractions	N/A	N/A	N/A	
DLC	Detection level classification	ADL	ADL	ADL	
FPM Results					
C _{sd}	Particulate Concentration (lb/dscf)	1.31E-06	1.92E-06	9.69E-07	1.40E-06
C _a	Particulate Concentration (lb/acf)	1.13E-06	1.62E-06	8.18E-07	1.19E-06
C _{sd}	Particulate Concentration (gr/dscf)	0.00919	0.0134	0.00678	0.00980
C _a	Particulate Concentration (gr/acf)	0.00787	0.0113	0.0057	0.0083
C _{sd}	Particulate Concentration (mg/dscm)	21.0	30.8	15.5	22.4
E _{lb/hr}	Particulate Rate (lb/hr)	0.897	1.37	0.725	0.998
E _{Rp}	Particulate Rate - Production-based (lb/tons of feed)	0.00278	0.00443	0.00227	0.00316
E _{Rp}	Particulate Rate - Production-based (kg/tons of feed)	0.00126	0.00201	0.00103	0.00143

**Table 2-2:
 TE Outlet – Particulate – 25/75**

Run No.		2	4	Average
Date (2017)		Sep 15	Sep 18	
Start Time (approx.)		12:21	11:14	
Stop Time (approx.)		13:36	12:33	
Process Conditions				
R _P	Production rate (tons of feed/hr)	315	311	313
P ₁	Process data - (light iron/automobiles)	21.16/78.84	24.97/75.03	23/77
Gas Conditions				
O ₂	Oxygen (dry volume %)	21.5	20.9	21.2
CO ₂	Carbon dioxide (dry volume %)	0.1	0.1	0.1
T _s	Sample temperature (°F)	105	108	107
B _w	Actual water vapor in gas (% by volume)	7.6	7.7	7.6
Gas Flow Rate				
Q _a	Volumetric flow rate, actual (acfm)	11,800	14,800	13,300
Q _s	Volumetric flow rate, standard (scfm)	10,900	13,600	12,200
Q _{std}	Volumetric flow rate, dry standard (dscfm)	10,000	12,600	11,300
Sampling Data				
V _{mstd}	Volume metered, standard (dscf)	29.16	44.87	37.01
%I	Isokinetic sampling (%)	101.8	103.4	102.6
Laboratory Data				
m _{filter}	Matter collected on filter(s) (g)	0.01020	0.01420	
m _s	Matter collected in solvent rinse(s) (g)	0.00840	0.01215	
m _n	Total FPM (g)	0.01860	0.02635	
n _{MDL}	Number of non-detectable fractions	N/A	N/A	
DLC	Detection level classification	ADL	ADL	
FPM Results				
C _{sd}	Particulate Concentration (lb/dscf)	1.41E-06	1.29E-06	1.35E-06
C _a	Particulate Concentration (lb/acf)	1.20E-06	1.10E-06	1.15E-06
C _{sd}	Particulate Concentration (gr/dscf)	0.00984	0.00906	0.00945
C _a	Particulate Concentration (gr/acf)	0.00840	0.00768	0.00804
C _{sd}	Particulate Concentration (mg/dscm)	22.52	20.74	21.63
E _{lb/hr}	Particulate Rate (lb/hr)	0.848	0.977	0.912
E _{Rp}	Particulate Rate - Production-based (lb/tons of feed)	0.0027	0.0031	0.0029
E _{Rp}	Particulate Rate - Production-based (kg/tons of feed)	0.0012	0.0014	0.0013

**Table 2-3:
 TE Outlet – Total Non-Methane Hydrocarbons – 50/50**

Run No.		1	3	5	Average
Date (2017)		Sep 15	Sep 18	Sep 20	
Start Time		9:14	8:38	8:58	
End Time		10:33	9:53	12:20	
Process Conditions					
R _P	Production Rate (tons of feed/hour)	323	310	319	317
Gas Conditions¹					
O ₂	Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂	Carbon dioxide (dry volume %)	0.1	0.1	0.03	0.1
T _s	Sample temperature (°F)	104	108	111	108
B _w	Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate¹					
Q _a	Volumetric flow rate, actual (acfm)	13,281	14,147	14,754	14,060
Q _s	Volumetric flow rate, standard (scfm)	12,286	12,989	13,490	12,922
Q _{std}	Volumetric flow rate, dry standard (dscfm)	11,383	11,901	12,459	11,915
Laboratory Data					
C _{sd}	Methane Concentration	4.7	4.8	5.2	4.9
C _{sd}	Methane Concentration, as propane	1.6	1.6	1.7	1.6
C _{sd}	Ethane Concentration	0.9	1.1	1.9	1.3
C _{sd}	Ethane Concentration, as propane	0.6	0.7	1.3	0.9
Total Hydrocarbon Results (as propane)					
C _{sd}	THC Concentration (ppmdv)	493	571	466	510
C _{sd}	TNMHC Concentration (ppmdv)	491	568	463	508
C _{lb/dscf}	TNMHC Concentration (lb/dscf)	5.62E-05	6.51E-05	5.30E-05	5.81E-05
E _{lb/hr}	TNMHC Mass Rate (lb/hr)	38.4	46.5	39.6	41.5
E _{lb/ton}	TNMHC Mass Rate (lb/ton of feed)	0.119	0.150	0.124	0.131

¹ Gas conditions and flow rate parameters obtained from concurrent Method 5/29 sampling.

**Table 2-4:
 TE Outlet – Total Non-Methane Hydrocarbons – 25/75**

Run No.		1	3	5	Average
Date (2017)		Sep 15	Sep 18	Sep 20	
Start Time		12:21	11:14	13:44	
End Time		13:36	12:33	15:33	
Process Conditions					
R _P	Production Rate (tons of feed/hour)	315	311	320	315
Gas Conditions¹					
O ₂	Oxygen (dry volume %)	21.5	20.9	21.0	21.1
CO ₂	Carbon dioxide (dry volume %)	0.1	0.1	0.03	0.1
T _s	Sample temperature (°F)	105	108	107	107
B _w	Actual water vapor in gas (% by volume)	7.6	7.7	5.3	6.8
Gas Flow Rate¹					
Q _a	Volumetric flow rate, actual (acfm)	11,766	14,830	15,061	13,886
Q _s	Volumetric flow rate, standard (scfm)	10,866	13,616	13,870	12,784
Q _{std}	Volumetric flow rate, dry standard (dscfm)	10,043	12,568	13,140	11,917
Laboratory Data					
C _{sd}	Methane Concentration	3.8	4.5	4.7	4.3
C _{sd}	Ethane Concentration, as propane	1.3	1.5	1.6	1.4
C _{sd}	Ethane Concentration	0	0	1.3	0.4
C _{sd}	Ethane Concentration, as propane	0	0	0.9	0.3
Total Hydrocarbon Results (as propane)					
C _{sd}	THC Concentration (ppmdv)	367	403	384	385
C _{sd}	TNMHC Concentration (ppmdv)	365	402	382	383
C _{lb/dscf}	TNMHC Concentration (lb/dscf)	4.18E-05	4.60E-05	4.37E-05	4.38E-05
E _{lb/hr}	TNMHC Mass Rate (lb/hr)	25.2	34.7	34.5	31.5
E _{lb/ton}	TNMHC Mass Rate (lb/ton of feed)	0.080	0.112	0.108	0.10

¹ Gas conditions and flow rate parameters obtained from concurrent Method 5/29 sampling.

**Table 2-5:
 TE Outlet – Hg, Be, P, and Cr – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _P Production rate - (tons of feed/hour)	323	310	319	317
Gas Conditions				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate				
Q _a Volumetric flow rate, actual (acfm)	13,300	14,100	14,800	14,100
Q _s Volumetric flow rate, standard (scfm)	12,300	13,000	13,500	12,900
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,400	11,900	12,500	11,900
Sampling Data				
V _{mstd} Volume metered, standard (dscf)	33.30	42.51	50.72	42.18
%I Isokinetic sampling (%)	102.6	103.5	103.4	103.2
Mercury Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	30.8407	52.5961	142.3234	
Mercury Results - Total				
C _{sd} Concentration (lb/dscf)	2.04E-09	2.73E-09	6.19E-09	3.65E-09
C _{sd} Concentration (µg/dscm)	3.27E+01	4.37E+01	9.91E+01	5.85E+01
C _{sd} Concentration (mg/dscm)	3.27E-02	4.37E-02	9.91E-02	5.85E-02
E _{lb/hr} Rate (lb/hr)	1.39E-03	1.95E-03	4.63E-03	2.66E-03
E _{Rp} Rate - Production-based (lb/ton of feed)	4.32E-06	6.29E-06	1.45E-05	8.37E-06
Beryllium Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	<0.0500	<0.0500	<0.0500	
Beryllium Results - Total				
C _{sd} Concentration (lb/dscf)	<3.31E-12	<2.59E-12	<2.17E-12	<2.69E-12
C _{sd} Concentration (µg/dscm)	<5.30E-02	<4.15E-02	<3.48E-02	<4.31E-02
C _{sd} Concentration (mg/dscm)	<5.30E-05	<4.15E-05	<3.48E-05	<4.31E-05
E _{lb/hr} Rate (lb/hr)	<2.26E-06	<1.85E-06	<1.63E-06	<1.91E-06
E _{Rp} Rate - Production-based (lb/ton of feed)	<7.00E-09	<5.98E-09	<5.09E-09	<6.02E-09
Phosphorus Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	34.4458	54.5229	53.9091	
Phosphorus Results - Total				
C _{sd} Concentration (lb/dscf)	2.28E-09	2.83E-09	2.34E-09	2.48E-09
C _{sd} Concentration (µg/dscm)	3.65E+01	4.53E+01	3.75E+01	3.98E+01
C _{sd} Concentration (mg/dscm)	3.65E-02	4.53E-02	3.75E-02	3.98E-02
E _{lb/hr} Rate (lb/hr)	1.56E-03	2.02E-03	1.75E-03	1.78E-03
E _{Rp} Rate - Production-based (lb/ton of feed)	4.82E-06	6.52E-06	5.49E-06	5.61E-06
Chromium Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	7.1245	11.3108	8.0472	
Chromium Results - Total				
C _{sd} Concentration (lb/dscf)	4.72E-10	5.87E-10	3.50E-10	4.69E-10
C _{sd} Concentration (µg/dscm)	7.55E+00	9.39E+00	5.60E+00	7.52E+00
C _{sd} Concentration (mg/dscm)	7.55E-03	9.39E-03	5.60E-03	7.52E-03
E _{lb/hr} Rate (lb/hr)	3.22E-04	4.19E-04	2.62E-04	3.34E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	9.97E-07	1.35E-06	8.20E-07	1.06E-06

**Table 2-6:
 TE Outlet – Co, Ni, Cu, and Zn – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _p Production rate - (tons of feed/hour)	323	310	319	317
Gas Conditions				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate				
Q _a Volumetric flow rate, actual (acfm)	13,300	14,100	14,800	14,100
Q _s Volumetric flow rate, standard (scfm)	12,300	13,000	13,500	12,900
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,400	11,900	12,500	11,900
Sampling Data				
V _{mstd} Volume metered, standard (dscf)	33.30	42.51	50.72	42.18
%I Isokinetic sampling (%)	102.6	103.5	103.4	103.2
Cobalt Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	0.7621	1.1822	0.7679	
Cobalt Results - Total				
C _{sd} Concentration (lb/dscf)	5.05E-11	6.13E-11	3.34E-11	4.84E-11
C _{sd} Concentration (µg/dscm)	8.08E-01	9.82E-01	5.35E-01	7.75E-01
C _{sd} Concentration (mg/dscm)	8.08E-04	9.82E-04	5.35E-04	7.75E-04
E _{l/hr} Rate (lb/hr)	3.45E-05	4.38E-05	2.50E-05	3.44E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	1.07E-07	1.41E-07	7.82E-08	1.09E-07
Nickel Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	5.3204	6.4394	6.1071	
Nickel Results - Total				
C _{sd} Concentration (lb/dscf)	3.52E-10	3.34E-10	2.66E-10	3.17E-10
C _{sd} Concentration (µg/dscm)	5.64E+00	5.35E+00	4.25E+00	5.08E+00
C _{sd} Concentration (mg/dscm)	5.64E-03	5.35E-03	4.25E-03	5.08E-03
E _{l/hr} Rate (lb/hr)	2.41E-04	2.39E-04	1.98E-04	2.26E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	7.45E-07	7.70E-07	6.22E-07	7.12E-07
Copper Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	10.6921	18.5226	14.1447	
Copper Results - Total				
C _{sd} Concentration (lb/dscf)	7.08E-10	9.61E-10	6.15E-10	7.61E-10
C _{sd} Concentration (µg/dscm)	1.13E+01	1.54E+01	9.85E+00	1.22E+01
C _{sd} Concentration (mg/dscm)	1.13E-02	1.54E-02	9.85E-03	1.22E-02
E _{l/hr} Rate (lb/hr)	4.84E-04	6.86E-04	4.60E-04	5.43E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	1.50E-06	2.21E-06	1.44E-06	1.72E-06
Zinc Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	802.7066	1097.2684	1097.9306	
Zinc Results - Total				
C _{sd} Concentration (lb/dscf)	5.32E-08	5.69E-08	4.77E-08	5.26E-08
C _{sd} Concentration (µg/dscm)	8.51E+02	9.11E+02	7.64E+02	8.42E+02
C _{sd} Concentration (mg/dscm)	8.51E-01	9.11E-01	7.64E-01	8.42E-01
E _{l/hr} Rate (lb/hr)	3.63E-02	4.06E-02	3.57E-02	3.75E-02
E _{Rp} Rate - Production-based (lb/ton of feed)	1.12E-04	1.31E-04	1.12E-04	1.18E-04

**Table 2-7:
 TE Outlet – As, Se, Ag, and Cd – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _p Production rate - (tons of feed/hour)	323	310	319	317
Gas Conditions				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate				
Q _a Volumetric flow rate, actual (acfm)	13,300	14,100	14,800	14,100
Q _s Volumetric flow rate, standard (scfm)	12,300	13,000	13,500	12,900
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,400	11,900	12,500	11,900
Sampling Data				
V _{mstd} Volume metered, standard (dscf)	33.30	42.51	50.72	42.18
%I Isokinetic sampling (%)	102.6	103.5	103.4	103.2
Arsenic Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	<1.0000	<1.0000	<1.0000	
Arsenic Results - Total				
C _{sd} Concentration (lb/dscf)	<6.62E-11	<5.19E-11	<4.35E-11	<5.39E-11
C _{sd} Concentration (µg/dscm)	<1.06E+00	<8.31E-01	<6.96E-01	<8.62E-01
C _{sd} Concentration (mg/dscm)	<1.06E-03	<8.31E-04	<6.96E-04	<8.62E-04
E _{lb/hr} Rate (lb/hr)	<4.52E-05	<3.70E-05	<3.25E-05	<3.83E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	<1.40E-07	<1.20E-07	<1.02E-07	<1.20E-07
Selenium Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	4.5895	3.8421	<1.0000	
Selenium Results - Total				
C _{sd} Concentration (lb/dscf)	3.04E-10	1.99E-10	<4.35E-11	<1.82E-10
C _{sd} Concentration (µg/dscm)	4.87E+00	3.19E+00	<6.96E-01	<2.92E+00
C _{sd} Concentration (mg/dscm)	4.87E-03	3.19E-03	<6.96E-04	<2.92E-03
E _{lb/hr} Rate (lb/hr)	2.08E-04	1.42E-04	<3.25E-05	<1.27E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	6.43E-07	4.59E-07	<1.02E-07	<4.01E-07
Silver Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	0.4471	0.3813	<0.2000	
Silver Results - Total				
C _{sd} Concentration (lb/dscf)	2.96E-11	1.98E-11	<8.70E-12	<1.94E-11
C _{sd} Concentration (µg/dscm)	4.74E-01	3.17E-01	<1.39E-01	<3.10E-01
C _{sd} Concentration (mg/dscm)	4.74E-04	3.17E-04	<1.39E-04	<3.10E-04
E _{lb/hr} Rate (lb/hr)	2.02E-05	1.41E-05	<6.50E-06	<1.36E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	6.26E-08	4.56E-08	<2.04E-08	<4.29E-08
Cadmium Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	3.0592	3.1889	3.4978	
Cadmium Results - Total				
C _{sd} Concentration (lb/dscf)	2.03E-10	1.65E-10	1.52E-10	1.73E-10
C _{sd} Concentration (µg/dscm)	3.24E+00	2.65E+00	2.44E+00	2.78E+00
C _{sd} Concentration (mg/dscm)	3.24E-03	2.65E-03	2.44E-03	2.78E-03
E _{lb/hr} Rate (lb/hr)	1.38E-04	1.18E-04	1.14E-04	1.23E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	4.28E-07	3.81E-07	3.56E-07	3.89E-07

**Table 2-8:
 TE Outlet – Sb, Ba, Tl, and Pb – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _p Production rate - (tons of feed/hour)	323	310	319	317
Gas Conditions				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate				
Q _a Volumetric flow rate, actual (acfm)	13,300	14,100	14,800	14,100
Q _s Volumetric flow rate, standard (scfm)	12,300	13,000	13,500	12,900
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,400	11,900	12,500	11,900
Sampling Data				
V _{mstd} Volume metered, standard (dscf)	33.30	42.51	50.72	42.18
%I Isokinetic sampling (%)	102.6	103.5	103.4	103.2
Antimony Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	1.6330	2.2132	1.9618	
Antimony Results - Total				
C _{sd} Concentration (lb/dscf)	1.08E-10	1.15E-10	8.53E-11	1.03E-10
C _{sd} Concentration (µg/dscm)	1.73E+00	1.84E+00	1.37E+00	1.65E+00
C _{sd} Concentration (mg/dscm)	1.73E-03	1.84E-03	1.37E-03	1.65E-03
E _{lb/hr} Rate (lb/hr)	7.39E-05	8.20E-05	6.38E-05	7.32E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	2.29E-07	2.65E-07	2.00E-07	2.31E-07
Barium Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	9.3704	16.9190	14.7591	
Barium Results - Total				
C _{sd} Concentration (lb/dscf)	6.20E-10	8.78E-10	6.42E-10	7.13E-10
C _{sd} Concentration (µg/dscm)	9.94E+00	1.41E+01	1.03E+01	1.14E+01
C _{sd} Concentration (mg/dscm)	9.94E-03	1.41E-02	1.03E-02	1.14E-02
E _{lb/hr} Rate (lb/hr)	4.24E-04	6.27E-04	4.80E-04	5.10E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	1.31E-06	2.02E-06	1.50E-06	1.61E-06
Thallium Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	<0.1000	<0.2000	<0.2000	
Thallium Results - Total				
C _{sd} Concentration (lb/dscf)	<6.62E-12	<1.04E-11	<8.70E-12	<8.56E-12
C _{sd} Concentration (µg/dscm)	<1.06E-01	<1.66E-01	<1.39E-01	<1.37E-01
C _{sd} Concentration (mg/dscm)	<1.06E-04	<1.66E-04	<1.39E-04	<1.37E-04
E _{lb/hr} Rate (lb/hr)	<4.52E-06	<7.41E-06	<6.50E-06	<6.14E-06
E _{Rp} Rate - Production-based (lb/ton of feed)	<1.40E-08	<2.39E-08	<2.04E-08	<1.94E-08
Lead Laboratory Data				
m _n Total matter corrected for allowable blanks (µg)	20.3060	50.9419	41.8721	
Lead Results - Total				
C _{sd} Concentration (lb/dscf)	1.34E-09	2.64E-09	1.82E-09	1.94E-09
C _{sd} Concentration (µg/dscm)	2.15E+01	4.23E+01	2.92E+01	3.10E+01
C _{sd} Concentration (mg/dscm)	2.15E-02	4.23E-02	2.92E-02	3.10E-02
E _{lb/hr} Rate (lb/hr)	9.18E-04	1.89E-03	1.36E-03	1.39E-03
E _{Rp} Rate - Production-based (lb/ton of feed)	2.84E-06	6.09E-06	4.26E-06	4.40E-06

**Table 2-9:
 TE Outlet – Hg, Be, P, and Cr – 25/75**

Run No.	2	4	Average
Date (2017)	Sep 15	Sep 18	
Start Time (approx.)	12:21	11:14	
Stop Time (approx.)	13:36	12:33	
Process Conditions			
R _P Production rate - (tons of feed/hour)	315	311	313
Gas Conditions			
O ₂ Oxygen (dry volume %)	21.5	20.9	21.2
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.1
T _s Sample temperature (°F)	105	108	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	7.6
Gas Flow Rate			
Q _a Volumetric flow rate, actual (acfm)	11,800	14,800	13,300
Q _s Volumetric flow rate, standard (scfm)	10,900	13,600	12,200
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,000	12,600	11,300
Sampling Data			
V _{mstd} Volume metered, standard (dscf)	29.16	44.87	37.01
%I Isokinetic sampling (%)	101.8	103.4	102.6
Mercury Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	26.9378	67.9026	
Mercury Results - Total			
C _{sd} Concentration (lb/dscf)	2.04E-09	3.34E-09	2.69E-09
C _{sd} Concentration (µg/dscm)	32.6	53.4	43.0
C _{sd} Concentration (mg/dscm)	0.0326	0.0534	0.0430
E _{lb/hr} Rate (lb/hr)	1.23E-03	2.52E-03	1.87E-03
E _{Rp} Rate - Production-based (lb/ton of feed)	3.90E-06	8.08E-06	5.99E-06
Beryllium Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	<0.0500	<0.0500	
Beryllium Results - Total			
C _{sd} Concentration (lb/dscf)	<3.78E-12	<2.46E-12	<3.12E-12
C _{sd} Concentration (µg/dscm)	<6.06E-02	<3.93E-02	<5.00E-02
C _{sd} Concentration (mg/dscm)	<6.06E-05	<3.93E-05	<5.00E-05
E _{lb/hr} Rate (lb/hr)	<2.28E-06	<1.85E-06	<2.07E-06
E _{Rp} Rate - Production-based (lb/ton of feed)	<7.23E-09	<5.95E-09	<6.59E-09
Phosphorus Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	40.5694	51.0394	
Phosphorus Results - Total			
C _{sd} Concentration (lb/dscf)	3.07E-09	2.51E-09	2.79E-09
C _{sd} Concentration (µg/dscm)	4.91E+01	4.02E+01	4.47E+01
C _{sd} Concentration (mg/dscm)	4.91E-02	4.02E-02	4.47E-02
E _{lb/hr} Rate (lb/hr)	1.85E-03	1.89E-03	1.87E-03
E _{Rp} Rate - Production-based (lb/ton of feed)	5.87E-06	6.08E-06	5.97E-06
Chromium Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	5.9141	9.0648	
Chromium Results - Total			
C _{sd} Concentration (lb/dscf)	4.47E-10	4.45E-10	4.46E-10
C _{sd} Concentration (µg/dscm)	7.16E+00	7.13E+00	7.15E+00
C _{sd} Concentration (mg/dscm)	7.16E-03	7.13E-03	7.15E-03
E _{lb/hr} Rate (lb/hr)	2.70E-04	3.36E-04	3.03E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	8.55E-07	1.08E-06	9.67E-07

Run 6 is not included in the averages

**Table 2-10:
 TE Outlet – Co, Ni, Cu, and Zn – 25/75**

Run No.	2	4	Average
Date (2017)	Sep 15	Sep 18	
Start Time (approx.)	12:21	11:14	
Stop Time (approx.)	13:36	12:33	
Process Conditions			
R _p Production rate - (tons of feed/hour)	315	311	313
Gas Conditions			
O ₂ Oxygen (dry volume %)	21.5	20.9	21.2
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.1
T _s Sample temperature (°F)	105	108	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	7.6
Gas Flow Rate			
Q _a Volumetric flow rate, actual (acfm)	11,800	14,800	13,300
Q _s Volumetric flow rate, standard (scfm)	10,900	13,600	12,200
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,000	12,600	11,300
Sampling Data			
V _{mstd} Volume metered, standard (dscf)	29.16	44.87	37.01
%I Isokinetic sampling (%)	101.8	103.4	102.6
Cobalt Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	0.7371	1.3602	
Cobalt Results - Total			
C _{sd} Concentration (lb/dscf)	5.57E-11	6.68E-11	6.13E-11
C _{sd} Concentration (µg/dscm)	8.93E-01	1.07E+00	9.82E-01
C _{sd} Concentration (mg/dscm)	8.93E-04	1.07E-03	9.82E-04
E _{lb/hr} Rate (lb/hr)	3.36E-05	5.04E-05	4.20E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	1.07E-07	1.62E-07	1.34E-07
Nickel Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	3.9051	5.8908	
Nickel Results - Total			
C _{sd} Concentration (lb/dscf)	2.95E-10	2.90E-10	2.92E-10
C _{sd} Concentration (µg/dscm)	4.73E+00	4.64E+00	4.68E+00
C _{sd} Concentration (mg/dscm)	4.73E-03	4.64E-03	4.68E-03
E _{lb/hr} Rate (lb/hr)	1.78E-04	2.18E-04	1.98E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	5.65E-07	7.01E-07	6.33E-07
Copper Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	11.1773	15.3266	
Copper Results - Total			
C _{sd} Concentration (lb/dscf)	8.45E-10	7.53E-10	7.99E-10
C _{sd} Concentration (µg/dscm)	1.35E+01	1.21E+01	1.28E+01
C _{sd} Concentration (mg/dscm)	1.35E-02	1.21E-02	1.28E-02
E _{lb/hr} Rate (lb/hr)	5.09E-04	5.68E-04	5.39E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	1.62E-06	1.82E-06	1.72E-06
Zinc Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	579.2605	1247.9456	
Zinc Results - Total			
C _{sd} Concentration (lb/dscf)	4.38E-08	6.13E-08	5.26E-08
C _{sd} Concentration (µg/dscm)	7.02E+02	9.82E+02	8.42E+02
C _{sd} Concentration (mg/dscm)	7.02E-01	9.82E-01	8.42E-01
E _{lb/hr} Rate (lb/hr)	2.64E-02	4.62E-02	3.63E-02
E _{Rp} Rate - Production-based (lb/ton of feed)	8.38E-05	1.49E-04	1.16E-04

Run 6 is not included in the averages

**Table 2-11:
 TE Outlet – As, Se, Ag, and Cd – 25/75**

Run No.	2	4	Average
Date (2017)	Sep 15	Sep 18	
Start Time (approx.)	12:21	11:14	
Stop Time (approx.)	13:36	12:33	
Process Conditions			
R _P Production rate - (tons of feed/hour)	315	311	313
Gas Conditions			
O ₂ Oxygen (dry volume %)	21.5	20.9	21.2
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.1
T _s Sample temperature (°F)	105	108	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	7.6
Gas Flow Rate			
Q _a Volumetric flow rate, actual (acfm)	11,800	14,800	13,300
Q _s Volumetric flow rate, standard (scfm)	10,900	13,600	12,200
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,000	12,600	11,300
Sampling Data			
V _{mstd} Volume metered, standard (dscf)	29.16	44.87	37.01
%I Isokinetic sampling (%)	101.8	103.4	102.6
Arsenic Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	<1.0000	<1.0000	
Arsenic Results - Total			
C _{sd} Concentration (lb/dscf)	<7.56E-11	<4.91E-11	<6.24E-11
C _{sd} Concentration (µg/dscm)	<1.21E+00	<7.87E-01	<9.99E-01
C _{sd} Concentration (mg/dscm)	<1.21E-03	<7.87E-04	<9.99E-04
E _{lb/hr} Rate (lb/hr)	<4.56E-05	<3.71E-05	<4.13E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	<1.45E-07	<1.19E-07	<1.32E-07
Selenium Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	2.4037	<1.0000	
Selenium Results - Total			
C _{sd} Concentration (lb/dscf)	1.82E-10	<4.91E-11	<1.15E-10
C _{sd} Concentration (µg/dscm)	2.91E+00	<7.87E-01	<1.85E+00
C _{sd} Concentration (mg/dscm)	2.91E-03	<7.87E-04	<1.85E-03
E _{lb/hr} Rate (lb/hr)	1.10E-04	<3.71E-05	<7.33E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	3.48E-07	<1.19E-07	<2.33E-07
Silver Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	0.2493	<0.2000	
Silver Results - Total			
C _{sd} Concentration (lb/dscf)	1.89E-11	<9.83E-12	<1.43E-11
C _{sd} Concentration (µg/dscm)	3.02E-01	<1.57E-01	<2.30E-01
C _{sd} Concentration (mg/dscm)	3.02E-04	<1.57E-04	<2.30E-04
E _{lb/hr} Rate (lb/hr)	1.14E-05	<7.41E-06	<9.39E-06
E _{Rp} Rate - Production-based (lb/ton of feed)	3.60E-08	<2.38E-08	<2.99E-08
Cadmium Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	1.9892	1.8674	
Cadmium Results - Total			
C _{sd} Concentration (lb/dscf)	1.50E-10	9.18E-11	1.21E-10
C _{sd} Concentration (µg/dscm)	2.41E+00	1.47E+00	1.94E+00
C _{sd} Concentration (mg/dscm)	2.41E-03	1.47E-03	1.94E-03
E _{lb/hr} Rate (lb/hr)	9.07E-05	6.92E-05	7.99E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	2.88E-07	2.22E-07	2.55E-07

Run 6 is not included in the averages

**Table 2-12:
 TE Outlet – Sb, Ba, Tl, and Pb – 25/75**

Run No.	2	4	Average
Date (2017)	Sep 15	Sep 18	
Start Time (approx.)	12:21	11:14	
Stop Time (approx.)	13:36	12:33	
Process Conditions			
R _P Production rate - (tons of feed/hour)	315	311	313
Gas Conditions			
O ₂ Oxygen (dry volume %)	21.5	20.9	21.2
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.1
T _s Sample temperature (°F)	105	108	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	7.6
Gas Flow Rate			
Q _a Volumetric flow rate, actual (acfm)	11,800	14,800	13,300
Q _s Volumetric flow rate, standard (scfm)	10,900	13,600	12,200
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,000	12,600	11,300
Sampling Data			
V _{mstd} Volume metered, standard (dscf)	29.16	44.87	37.01
%I Isokinetic sampling (%)	101.8	103.4	102.6
Antimony Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	1.3124	2.1588	
Antimony Results - Total			
C _{sd} Concentration (lb/dscf)	9.93E-11	1.06E-10	1.03E-10
C _{sd} Concentration (µg/dscm)	1.59E+00	1.70E+00	1.64E+00
C _{sd} Concentration (mg/dscm)	1.59E-03	1.70E-03	1.64E-03
E _{lb/hr} Rate (lb/hr)	5.98E-05	8.00E-05	6.99E-05
E _{Rp} Rate - Production-based (lb/ton of feed)	1.90E-07	2.57E-07	2.23E-07
Barium Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	9.1778	13.9005	
Barium Results - Total			
C _{sd} Concentration (lb/dscf)	6.94E-10	6.83E-10	6.89E-10
C _{sd} Concentration (µg/dscm)	1.11E+01	1.09E+01	1.10E+01
C _{sd} Concentration (mg/dscm)	1.11E-02	1.09E-02	1.10E-02
E _{lb/hr} Rate (lb/hr)	4.18E-04	5.15E-04	4.67E-04
E _{Rp} Rate - Production-based (lb/ton of feed)	1.33E-06	1.65E-06	1.49E-06
Thallium Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	<0.2000	<0.2000	
Thallium Results - Total			
C _{sd} Concentration (lb/dscf)	<1.51E-11	<9.83E-12	<1.25E-11
C _{sd} Concentration (µg/dscm)	<2.42E-01	<1.57E-01	<2.00E-01
C _{sd} Concentration (mg/dscm)	<2.42E-04	<1.57E-04	<2.00E-04
E _{lb/hr} Rate (lb/hr)	<9.12E-06	<7.41E-06	<8.26E-06
E _{Rp} Rate - Production-based (lb/ton of feed)	<2.89E-08	<2.38E-08	<2.64E-08
Lead Laboratory Data			
m _n Total matter corrected for allowable blanks (µg)	21.7427	46.3399	
Lead Results - Total			
C _{sd} Concentration (lb/dscf)	1.64E-09	2.28E-09	1.96E-09
C _{sd} Concentration (µg/dscm)	2.63E+01	3.65E+01	3.14E+01
C _{sd} Concentration (mg/dscm)	2.63E-02	3.65E-02	3.14E-02
E _{lb/hr} Rate (lb/hr)	9.91E-04	1.72E-03	1.35E-03
E _{Rp} Rate - Production-based (lb/ton of feed)	3.14E-06	5.52E-06	4.33E-06

Run 6 is not included in the averages

**Table 2-13:
 TE Outlet – TO-15 VOCs – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _P Production rate - (tons/hour)	323	310	319	317
P ₁ Process data - (mix)	44.28/55.72	48.35/51.65	45.47/54.53	46/54
Gas Conditions¹				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate¹				
Q _a Volumetric flow rate, actual (acfm)	13,281	14,147	14,754	14,060
Q _s Volumetric flow rate, standard (scfm)	12,286	12,989	13,490	12,922
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,383	11,901	12,459	11,915
Chlorodifluoromethane (CHClF₂) Results*				
C _{sd} Chlorodifluoromethane Concentration (lb/dscf)	7.65E-07	1.10E-06	1.82E-06	1.23E-06
C _{sd} Chlorodifluoromethane Concentration (ppmdv)	3.41	4.92	8.10	5.48
C _{sd} Chlorodifluoromethane Concentration (mg/dscm)	12.3	17.7	29.1	19.7
E _{lb/hr} Chlorodifluoromethane Rate (lb/hr)	0.523	0.788	1.36	0.890
E _{Rp} Chlorodifluoromethane Rate - Production-based (lb/ton of feed)	1.62E-03	2.54E-03	4.26E-03	2.81E-03
Propene (C₃H₆) Results				
C _{sd} Propene Concentration (lb/dscf)	2.45E-08	5.96E-08	4.82E-07	1.89E-07
C _{sd} Propene Concentration (ppmdv)	0.224	0.546	4.41	1.73
C _{sd} Propene Concentration (mg/dscm)	0.392	0.955	7.71	3.02
E _{lb/hr} Propene Rate (lb/hr)	0.0167	0.0426	0.360	0.140
E _{Rp} Chlorodifluoromethane Rate - Production-based (lb/ton of feed)	5.17E-05	1.37E-04	1.13E-03	4.39E-04
Dichlorodifluoromethane (CCl₂F₂) Results*				
C _{sd} Dichlorodifluoromethane Concentration (lb/dscf)	5.90E-07	1.91E-06	1.24E-06	1.25E-06
C _{sd} Dichlorodifluoromethane Concentration (ppmdv)	1.88	6.10	3.94	3.97
C _{sd} Dichlorodifluoromethane Concentration (mg/dscm)	9.45	30.7	19.8	20.0
E _{lb/hr} Dichlorodifluoromethane Rate (lb/hr)	0.403	1.37	0.924	0.898
E _{Rp} Chlorodifluoromethane Rate - Production-based (lb/ton of feed)	1.25E-03	4.41E-03	2.90E-03	2.85E-03
Trichlorofluoromethane (CCl₃F) Results*				
C _{sd} Trichlorofluoromethane Concentration (lb/dscf)	3.09E-06	1.50E-06	1.56E-06	2.05E-06
C _{sd} Trichlorofluoromethane Concentration (ppmdv)	8.67	4.22	4.37	5.75
C _{sd} Trichlorofluoromethane Concentration (mg/dscm)	49.5	24.1	24.9	32.845
E _{lb/hr} Trichlorofluoromethane Rate (lb/hr)	2.11	1.07	1.16	1.450
E _{Rp} Chlorodifluoromethane Rate - Production-based (lb/ton of feed)	6.53E-03	3.47E-03	3.65E-03	4.55E-03
Dichlorotetrafluoroethane (CHClF₂) Results*				
C _{sd} Dichlorotetrafluoroethane Concentration (lb/dscf)	<8.16E-09	<8.07E-09	4.57E-08	<2.06E-08
C _{sd} Dichlorotetrafluoroethane Concentration (ppmdv)	<0.0184	<0.0182	0.103	<0.0465
C _{sd} Dichlorotetrafluoroethane Concentration (mg/dscm)	<0.131	<0.129	0.732	<0.331
E _{lb/hr} Dichlorotetrafluoroethane Rate (lb/hr)	<0.00557	<0.00577	0.0342	<0.0152
E _{Rp} Dichlorotetrafluoroethane Rate - Production-based (lb/ton of feed)	<1.73E-05	<1.86E-05	1.07E-04	<4.76E-05

¹ Gas conditions and flow rate parameters obtained from concurrent Method 5/29 sampling.

* Exempt VOC per RIDEM Air Pollution Control Regulation Part 0 Definitions

**Table 2-14:
 TE Outlet – TO-15 TIC VOCs – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _P Production rate - (tons of feed/hr)	323	310	319	317
P ₁ Process data - (light iron/automobiles)	44.28/55.72	48.35/51.65	45.47/54.53	46/54
Gas Conditions¹				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.35	8.37	7.64	7.79
Gas Flow Rate¹				
Q _a Volumetric flow rate, actual (acfm)	13,281	14,147	14,754	14,060
Q _s Volumetric flow rate, standard (scfm)	12,286	12,989	13,490	12,922
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,383	11,901	12,459	11,915
Norflurane (C2H2F4) Results*				
C _{sd} Norflurane Concentration (lb/dscf)	2.224E-06	2.675E-06	1.223E-06	2.041E-06
C _{sd} Norflurane Concentration (ppmdv)	8.4000	10.1000	4.6200	7.7067
C _w Norflurane Concentration (ppmwv)	7.7826	9.2547	4.2668	7.1014
C _{sd} Norflurane Concentration (mg/dscm)	35.6203	42.8291	19.5912	32.6802
E _{lb/hr} Norflurane Rate (lb/hr)	1.5192	1.9099	0.9146	1.4479
E _{Rp} Norflurane Rate - Production-based (lb/tons of feed)	4.70E-03	6.16E-03	2.87E-03	4.58E-03
1-Chloro-1-fluoroethene (C2H2ClF) Results				
C _{sd} 1-Chloro-1-fluoroethene Concentration (lb/dscf)	1.134E-08	1.928E-08	2.066E-08	1.709E-08
C _{sd} 1-Chloro-1-fluoroethene Concentration (ppmdv)	0.0543	0.0923	0.0989	0.0818
C _w 1-Chloro-1-fluoroethene Concentration (ppmwv)	0.0503	0.0846	0.0913	0.0754
C _{sd} 1-Chloro-1-fluoroethene Concentration (mg/dscm)	0.1816	0.3088	0.3308	0.2737
E _{lb/hr} 1-Chloro-1-fluoroethene Rate (lb/hr)	0.0077	0.0138	0.0154	0.0123
E _{Rp} 1-Chloro-1-fluoroethene Rate - Production-based (lb/tons of feed)	2.40E-05	4.44E-05	4.84E-05	3.89E-05
Isobutane (C4H10) Results				
C _{sd} Isobutane Concentration (lb/dscf)	8.719E-08	1.222E-07	<2.640E-09	<7.067E-08
C _{sd} Isobutane Concentration (ppmdv)	0.5780	0.8100	<0.0175	<0.4685
C _w Isobutane Concentration (ppmwv)	0.5355	0.7422	<0.0162	<0.4313
C _{sd} Isobutane Concentration (mg/dscm)	1.3962	1.9566	<0.0423	<1.1317
E _{lb/hr} Isobutane Rate (lb/hr)	0.0595	0.0872	<0.0020	<0.0496
E _{Rp} Isobutane Rate - Production-based (lb/tons of feed)	1.84E-04	2.82E-04	<6.18E-06	<1.57E-04
Butane (C4H10) Results				
C _{sd} Butane Concentration (lb/dscf)	9.503E-08	1.569E-07	1.057E-07	1.192E-07
C _{sd} Butane Concentration (ppmdv)	0.6300	1.0400	0.7010	0.7903
C _w Butane Concentration (ppmwv)	0.5837	0.9530	0.6474	0.7280
C _{sd} Butane Concentration (mg/dscm)	1.5218	2.5122	1.6933	1.9091
E _{lb/hr} Butane Rate (lb/hr)	0.0649	0.1120	0.0790	0.0853
E _{Rp} Butane Rate - Production-based (lb/tons of feed)	2.01E-04	3.62E-04	2.48E-04	2.70E-04

¹ Gas conditions and flow rate parameters obtained from concurrent Method 5/29 sampling.

* Exempt VOC per RIDEM Air Pollution Control Regulation Part 0 Definitions

**Table 2-14 (Continued):
TE Outlet – TO-15 TIC VOCs – 50/50**

Run No.	1	3	5	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	09:14	08:38	08:58	
Stop Time (approx.)	10:33	09:53	12:20	
Process Conditions				
R _P Production rate - (tons of feed/hr)	323	310	319	317
P ₁ Process data - (light iron/automobiles)	44.28/55.72	48.35/51.65	45.47/54.53	46/54
Gas Conditions¹				
O ₂ Oxygen (dry volume %)	21.0	21.0	21.0	21.0
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	104	108	111	108
B _w Actual water vapor in gas (% by volume)	7.3	8.4	7.6	7.8
Gas Flow Rate¹				
Q _a Volumetric flow rate, actual (acfm)	13,281	14,147	14,754	14,060
Q _s Volumetric flow rate, standard (scfm)	12,286	12,989	13,490	12,922
Q _{std} Volumetric flow rate, dry standard (dscfm)	11,383	11,901	12,459	11,915
2-Methylbutane (C5H12) Results				
C _{sd} 2-Methylbutane Concentration (lb/dscf)	2.92E-07	7.40E-08	3.58E-08	1.34E-07
C _{sd} 2-Methylbutane Concentration (ppmdv)	1.56	0.395	0.191	0.72
C _w 2-Methylbutane Concentration (ppmwv)	1.45	0.362	0.176	0.66
C _{sd} 2-Methylbutane Concentration (mg/dscm)	4.7	1.18	0.573	2.15
E _{lb/hr} 2-Methylbutane Rate (lb/hr)	0.200	0.0528	0.0267	0.093
E _{Rp} 2-Methylbutane Rate - Production-based (lb/tons of feed)	6.18E-04	1.70E-04	8.38E-05	2.91E-04
Pentane (C5H12) Results				
C _{sd} Pentane Concentration (lb/dscf)	1.07E-07	1.47E-08	<3.28E-09	<4.18E-08
C _{sd} Pentane Concentration (ppmdv)	0.574	0.0783	<0.0175	<0.223
C _w Pentane Concentration (ppmwv)	0.532	0.0717	<0.0162	<0.207
C _{sd} Pentane Concentration (mg/dscm)	1.72	0.235	<0.0525	<0.669
E _{lb/hr} Pentane Rate (lb/hr)	0.0734	0.0105	<0.0024	<0.0288
E _{Rp} Pentane Rate - Production-based (lb/tons of feed)	2.27E-04	3.38E-05	<7.68E-06	<8.96E-05
Cyclopentane (C5H10) Results				
C _{sd} Cyclopentane Concentration (lb/dscf)	6.75E-07	7.42E-08	5.42E-08	2.68E-07
C _{sd} Cyclopentane Concentration (ppmdv)	3.71	0.4080	0.2980	1.47
C _w Cyclopentane Concentration (ppmwv)	3.44	0.3739	0.2752	1.36
C _{sd} Cyclopentane Concentration (mg/dscm)	10.8	1.19	0.868	4.29
E _{lb/hr} Cyclopentane Rate (lb/hr)	0.461	0.0530	0.0405	0.185
E _{Rp} Cyclopentane Rate - Production-based (lb/tons of feed)	1.43E-03	1.71E-04	1.27E-04	5.75E-04
1,2-Propadiene (C3H4) Results				
C _{sd} 1,2-Propadiene Concentration (lb/dscf)	<1.82E-09	<1.82E-09	4.10E-08	<1.49E-08
C _{sd} 1,2-Propadiene Concentration (ppmdv)	<0.0175	<0.0175	0.394	<0.143
C _w 1,2-Propadiene Concentration (ppmwv)	<0.0162	<0.0160	0.364	<0.132
C _{sd} 1,2-Propadiene Concentration (mg/dscm)	<0.0291	<0.0291	0.656	<0.238
E _{lb/hr} 1,2-Propadiene Rate (lb/hr)	<0.00124	<0.00130	0.0306	<0.0111
E _{Rp} 1,2-Propadiene Rate - Production-based (lb/tons of feed)	<3.85E-06	<4.19E-06	9.60E-05	<3.47E-05

¹ Gas conditions and flow rate parameters obtained from concurrent Method 5/29 sampling.

**Table 2-15:
 TE Outlet – TO-15 VOCs – 25/75**

Run No.	2	4	6	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	12:21	11:14	13:44	
Stop Time (approx.)	13:36	12:33	15:33	
Process Conditions				
R _P Production rate - (tons/hour)	315	311	320	315
P ₁ Process data - (light iron/automobiles)	21.16/78.84	24.97/75.03	25.87/74.13	24/76
Gas Conditions¹				
O ₂ Oxygen (dry volume %)	21.5	20.9	21.0	21.1
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	105	108	107	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	5.3	6.8
Gas Flow Rate¹				
Q _a Volumetric flow rate, actual (acfm)	11,766	14,830	15,061	13,886
Q _s Volumetric flow rate, standard (scfm)	10,866	13,616	13,870	12,784
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,043	12,568	13,140	11,917
Chlorodifluoromethane (CHClF₂) Results*				
C _{sd} Chlorodifluoromethane Concentration (lb/dscf)	4.26E-07	4.13E-07	3.88E-07	4.09E-07
C _{sd} Chlorodifluoromethane Concentration (ppmdv)	1.90	1.84	1.73	1.82
C _w Chlorodifluoromethane Concentration (ppmwv)	1.76	1.70	1.64	1.70
C _{sd} Chlorodifluoromethane Concentration (mg/dscm)	6.83	6.61	6.22	6.55
E _{lb/hr} Chlorodifluoromethane Rate (lb/hr)	0.257	0.311	0.306	0.291
E _{Rp} Chlorodifluoromethane Rate - Production-based (lb/ton of feed)	8.15E-04	1.00E-03	9.57E-04	9.24E-04
Propene (C₃H₆) Results				
C _{sd} Propene Concentration (lb/dscf)	2.66E-08	3.16E-08	4.39E-08	3.40E-08
C _{sd} Propene Concentration (ppmdv)	0.244	0.289	0.402	0.312
C _w Propene Concentration (ppmwv)	0.226	0.267	0.381	0.291
C _{sd} Propene Concentration (mg/dscm)	0.427	0.505	0.703	0.545
E _{lb/hr} Propene Rate (lb/hr)	0.0161	0.0238	0.0346	0.0248
E _{Rp} Propene Rate - Production-based (lb/ton of feed)	5.09E-05	7.65E-05	1.08E-04	7.86E-05
Dichlorodifluoromethane (CCl₂F₂) Results*				
C _{sd} Dichlorodifluoromethane Concentration (lb/dscf)	3.39E-07	3.55E-07	3.95E-07	3.63E-07
C _{sd} Dichlorodifluoromethane Concentration (ppmdv)	1.08	1.13	1.26	1.16
C _w Dichlorodifluoromethane Concentration (ppmwv)	0.998	1.04	1.19	1.08
C _{sd} Dichlorodifluoromethane Concentration (mg/dscm)	5.43	5.68	6.33	5.81
E _{lb/hr} Dichlorodifluoromethane Rate (lb/hr)	0.204	0.267	0.312	0.261
E _{Rp} Dichlorodifluoromethane Rate - Production-based (lb/ton of feed)	6.48E-04	8.59E-04	9.75E-04	8.27E-04
Trichlorofluoromethane (CCl₃F) Results*				
C _{sd} Trichlorofluoromethane Concentration (lb/dscf)	4.28E-07	6.74E-08	2.11E-07	2.35E-07
C _{sd} Trichlorofluoromethane Concentration (ppmdv)	1.20	0.189	0.591	0.660
C _w Trichlorofluoromethane Concentration (ppmwv)	1.11	0.174	0.560	0.615
C _{sd} Trichlorofluoromethane Concentration (mg/dscm)	6.85	1.08	3.37	3.77
E _{lb/hr} Trichlorofluoromethane Rate (lb/hr)	0.258	0.0508	0.166	0.158
E _{Rp} Trichlorofluoromethane Rate - Production-based (lb/ton of feed)	8.18E-04	1.63E-04	5.19E-04	5.00E-04

¹ Gas conditions and flow rate parameters obtained from concurrent Method 5/29 sampling.

* Exempt VOC per RIDEM Air Pollution Control Regulation Part 0 Definitions

**Table 2-16:
 TE Outlet – TO-15 TIC VOCs – 25/75**

Run No.	2	4	6	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	12:21	11:14	13:44	
Stop Time (approx.)	13:36	12:33	15:33	
Process Conditions				
R _P Production rate - (tons of feed/hr)	315	311	320	315
Gas Conditions¹				
O ₂ Oxygen (dry volume %)	21.5	20.9	21.0	21.1
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	105	108	107	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	5.3	6.8
Gas Flow Rate¹				
Q _a Volumetric flow rate, actual (acfm)	11,766	14,830	15,061	13,886
Q _s Volumetric flow rate, standard (scfm)	10,866	13,616	13,870	12,784
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,043	12,568	13,140	11,917
Norflurane (C2H2F4) Results*				
C _{sd} Norflurane Concentration (lb/dscf)	3.73E-07	6.81E-07	4.58E-07	5.04E-07
C _{sd} Norflurane Concentration (ppmdv)	1.41	2.57	1.73	1.90
C _{sd} Norflurane Concentration (mg/dscm)	5.98	10.90	7.34	8.07
E _{lb/hr} Norflurane Rate (lb/hr)	0.225	0.513	0.361	0.366
E _{Rp} Norflurane Rate - Production-based (lb/ton of feed)	7.14E-04	1.65E-03	1.13E-03	1.16E-03
1-Chloro-1-fluoroethene (C2H2ClF) Results				
C _{sd} 1-Chloro-1-fluoroethene Concentration (lb/dscf)	4.39E-09	8.19E-09	7.35E-09	6.64E-09
C _{sd} 1-Chloro-1-fluoroethene Concentration (ppmdv)	0.0210	0.0392	0.0352	0.0318
C _{sd} 1-Chloro-1-fluoroethene Concentration (mg/dscm)	0.0702	0.1311	0.1177	0.1064
E _{lb/hr} 1-Chloro-1-fluoroethene Rate (lb/hr)	0.00264	0.00617	0.00580	0.00487
E _{Rp} 1-Chloro-1-fluoroethene Rate - Production-based (lb/ton of feed)	8.39E-06	1.98E-05	1.81E-05	1.55E-05
Isobutane (C4H10) Results				
C _{sd} Isobutane Concentration (lb/dscf)	4.22E-08	5.82E-08	3.94E-08	4.66E-08
C _{sd} Isobutane Concentration (ppmdv)	0.280	0.386	0.261	0.309
C _{sd} Isobutane Concentration (mg/dscm)	0.676	0.932	0.630	0.746
E _{lb/hr} Isobutane Rate (lb/hr)	0.0255	0.0439	0.0310	0.0335
E _{Rp} Isobutane Rate - Production-based (lb/ton of feed)	8.08E-05	1.41E-04	9.71E-05	1.06E-04
Butane (C4H10) Results				
C _{sd} Butane Concentration (lb/dscf)	6.86E-08	1.14E-07	7.20E-08	8.50E-08
C _{sd} Butane Concentration (ppmdv)	0.455	0.758	0.477	0.563
C _{sd} Butane Concentration (mg/dscm)	1.10	1.83	1.15	1.36
E _{lb/hr} Butane Rate (lb/hr)	0.0414	0.0862	0.0567	0.0614
E _{Rp} Butane Rate - Production-based (lb/ton of feed)	1.31E-04	2.77E-04	1.77E-04	1.95E-04
2-Methylbutane (C5H12) Results				
C _{sd} 2-Methylbutane Concentration (lb/dscf)	1.78E-07	<3.45E-09	3.24E-08	<7.13E-08
C _{sd} 2-Methylbutane Concentration (ppmdv)	0.951	<0.0184	0.173	<0.381
C _{sd} 2-Methylbutane Concentration (mg/dscm)	2.85	<0.0552	0.519	<1.14
E _{lb/hr} 2-Methylbutane Rate (lb/hr)	0.107	<0.0026	0.0255	<0.0452
E _{Rp} 2-Methylbutane Rate - Production-based (lb/ton of feed)	3.40E-04	<8.35E-06	7.99E-05	<1.43E-04

¹ Gas conditions and flow rate parameters obtained from concurrent 5/29 sampling.

* Exempt VOC per RIDEM Air Pollution Control Regulation Part 0 Definitions

**Table 2-16 (Continued):
TE Outlet – TO-15 TIC VOCs – 25/75**

Run No.	2	4	6	Average
Date (2017)	Sep 15	Sep 18	Sep 20	
Start Time (approx.)	12:21	11:14	13:44	
Stop Time (approx.)	13:36	12:33	15:33	
Process Conditions				
R _P Production rate - (tons of feed/hr)	315	311	320	315
Gas Conditions¹				
O ₂ Oxygen (dry volume %)	21.5	20.9	21.0	21.1
CO ₂ Carbon dioxide (dry volume %)	0.1	0.1	0.0	0.1
T _s Sample temperature (°F)	105	108	107	107
B _w Actual water vapor in gas (% by volume)	7.6	7.7	5.3	6.8
Gas Flow Rate¹				
Q _a Volumetric flow rate, actual (acfm)	11,766	14,830	15,061	13,886
Q _s Volumetric flow rate, standard (scfm)	10,866	13,616	13,870	12,784
Q _{std} Volumetric flow rate, dry standard (dscfm)	10,043	12,568	13,140	11,917
Pentane (C5H12) Results				
C _{sd} Pentane Concentration (lb/dscf)	7.55E-08	<3.45E-09	5.11E-09	<2.80E-08
C _{sd} Pentane Concentration (ppmdv)	0.403	<0.0184	0.0273	<0.15
C _{sd} Pentane Concentration (mg/dscm)	1.21	<0.0552	0.0819	<0.45
E _{lb/hr} Pentane Rate (lb/hr)	0.0455	<0.00260	0.00403	<0.0174
E _{Rp} Pentane Rate - Production-based (lb/ton of feed)	1.44E-04	<8.35E-06	1.26E-05	<5.51E-05
Cyclopentane (C5H10) Results				
C _{sd} Cyclopentane Concentration (lb/dscf)	1.68E-07	<3.35E-09	4.15E-08	<7.10E-08
C _{sd} Cyclopentane Concentration (ppmdv)	0.924	<0.0184	0.228	<0.390
C _{sd} Cyclopentane Concentration (mg/dscm)	2.69	<0.0536	0.664	<1.14
E _{lb/hr} Cyclopentane Rate (lb/hr)	0.101	<0.00252	0.0327	<0.0455
E _{Rp} Cyclopentane Rate - Production-based (lb/ton of feed)	3.21E-04	<8.11E-06	1.02E-04	<1.44E-04
1,1-Difluoroethane (C2H4F2) Results				
C _{sd} 1,1-Difluoroethane Concentration (lb/dscf)	3.43E-09	<3.15E-09	<3.00E-09	<3.19E-09
C _{sd} 1,1-Difluoroethane Concentration (ppmdv)	0.0200	<0.0184	<0.0175	<0.0186
C _{sd} 1,1-Difluoroethane Concentration (mg/dscm)	0.0549	<0.0505	<0.0480	<0.0512
E _{lb/hr} 1,1-Difluoroethane Rate (lb/hr)	0.00207	<0.00238	<0.0024	<0.00227
E _{Rp} 1,1-Difluoroethane Rate - Production-based (lb/ton of feed)	6.56E-06	<7.64E-06	<7.40E-06	<7.20E-06
2-Methyl-1-propene (C4H8) Results				
C _{sd} 2-Methyl-1-propene Concentration (lb/dscf)	1.38E-07	<2.68E-09	<2.55E-09	<4.79E-08
C _{sd} 2-Methyl-1-propene Concentration (ppmdv)	0.951	<0.0184	<0.0175	<0.329
C _{sd} 2-Methyl-1-propene Concentration (mg/dscm)	2.22	<0.0429	<0.0408	<0.767
E _{lb/hr} 2-Methyl-1-propene Rate (lb/hr)	0.0835	<0.00202	<0.00201	<0.0292
E _{Rp} 2-Methyl-1-propene Rate - Production-based (lb/ton of feed)	2.65E-04	<6.49E-06	<6.28E-06	<9.25E-05
1,2-Propadiene (C3H4) Results				
C _{sd} 1,2-Propadiene Concentration (lb/dscf)	<1.91E-09	<1.91E-09	4.33E-09	<2.72E-09
C _{sd} 1,2-Propadiene Concentration (ppmdv)	<0.0184	<0.0184	0.0416	<0.0261
C _{sd} 1,2-Propadiene Concentration (mg/dscm)	<0.0306	<0.0306	0.0693	<0.0435
E _{lb/hr} 1,2-Propadiene Rate (lb/hr)	<0.00115	<0.00144	0.00341	<0.00200
E _{Rp} 1,2-Propadiene Rate - Production-based (lb/ton of feed)	<3.66E-06	<4.64E-06	1.07E-05	<6.32E-06

¹ Gas conditions and flow rate parameters obtained from concurrent 5/29 sampling.

3. DESCRIPTION OF INSTALLATION

Process Description

At the Facility, SMMNEC prepares recyclable metal materials for production of specification-grade ferrous metal (e.g., steel) for use as feedstock in steel mills around the world. SMMNEC prepares such materials by means of mechanical shredding using a hammer mill and subsequent additional mechanical separation using electromagnets and other mechanical means. The shredder has a rated throughput capacity of 350 gross tons per hour.

The testing reported in this document was performed at the outlet of the TE, which has ductwork and a fan attached, as shown in Figure 3-1. The TE was constructed at the outlet of the UMO specifically for this test program, as approved by the USEPA.

**Figure 3-1:
Sampling Location**



Test Location

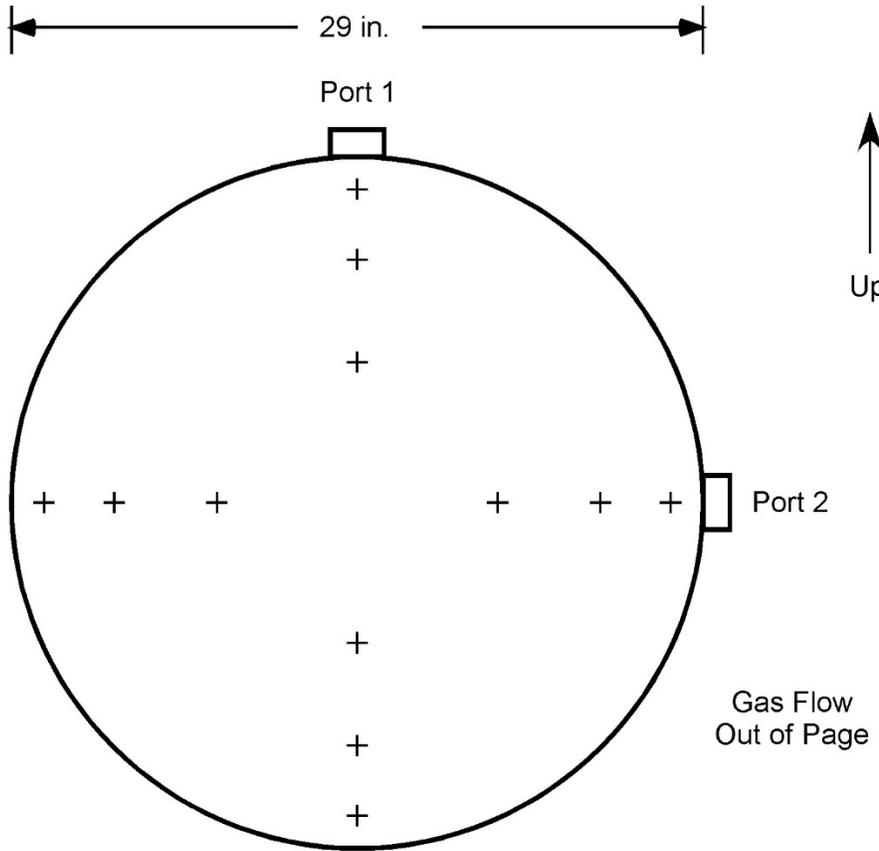
EPA Method 1 specifications were used to determine the sample point locations. Table 3-1 presents the sampling information for the test location. The figure shown on page 28 represents the layout of the test location.

**Table 3-1:
 Sampling Information**

<u>Source</u>		Run		Points per	Minutes per	Total	
Constituent	Method	No.	Ports	Port	Point	Minutes	Figure
<u>Shredder Outlet</u>							
FPM/Metals	EPA M5/29	1-6	2	6	5	60	3-2
O ₂ ,CO ₂ /THC(M18)	EPA 3A/25A(18)	1-6	1	1	1	60	NA
Speciated SVOCs	TO-15	1-6	1	1	1	60	NA

¹ THC and SVOCs were sampled at the approximate center of the duct.

**Figure 3-2:
 TE Outlet Sample Point Layout (EPA Method 1)**



Sampling Point	% of Stack Diameter	Port to Point Distance (inches)
1	95.6	27.7
2	85.4	24.8
3	70.4	20.4
4	29.6	8.6
5	14.6	4.2
6	4.4	1.3

Duct diameters upstream from flow disturbance (A): >2.0

Limit: 0.5

Duct diameters downstream from flow disturbance (B): >8.0

Limit: 2.0

4. METHODOLOGY

Procedures and Regulations

The test program sampling measurements followed methods and requirements as set out by the USEPA. These methods are described in Code of Federal Regulations (CFR) Title 40 and at <https://www.epa.gov/emc>. Appendix A includes diagrams of the sampling apparatus, as well as specifications for sampling, recovery and analytical procedures.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA “Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods,” EPA/600/R-94/038C. Appendix D contains additional QA/QC measures, as outlined in CleanAir’s internal Quality Manual.

Title 40 CFR Part 60, Appendix A

Method 1	“Sample and Velocity Traverses for Stationary Sources”
Method 2	“Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)”
Method 3	“Gas Analysis for the Determination of Dry Molecular Weight”
Method 3A	“Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)”
Method 4	“Determination of Moisture Content in Stack Gases”
Method 5	“Determination of Particulate Matter Emissions from Stationary Sources”
Method 25A	“Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer”
Method 29	“Determination of Metals Emissions from Stationary Sources”

EPA Air Method

Toxic Organics (TO)-15	“Determination of Volatile Organic Compounds (VOCs) in Air Collected Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)”
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Note: 8270C is a laboratory method which was utilized to analyze the impinger and silica gel samples.

End of Section

5. *APPENDIX*

Appendix A: Test Method Specifications

Appendix B: Sample Calculations

Appendix C: Parameters

Appendix D: QA/QC Data

Appendix E: Field Data

Appendix F: Field Data Printouts

Appendix G: Reference Method Monitor Data

Appendix H: Laboratory Data

Appendix I: Facility Operating Data

Appendix J: Enclosure Drawings and Pictures

Appendix K: CleanAir Resumes and Certifications